SOME BIOCHEMICHAL STUDIES ON THE HAEMOLYMPH OF S. GREGARIA DURING METAMORPHOSIS.

By

NAGI SABET HASSAN

B.Sc. (Agric.Biochemistry), Ain Shams Univ., 1970

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Name of Student : Nagi Sabet Hassan.

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Approved by :

Prof. Dr. El-Hadidy

Prof. Dr. R. El-gohash

Prof. Dr. Hassan Salem

(Committee in Charge)

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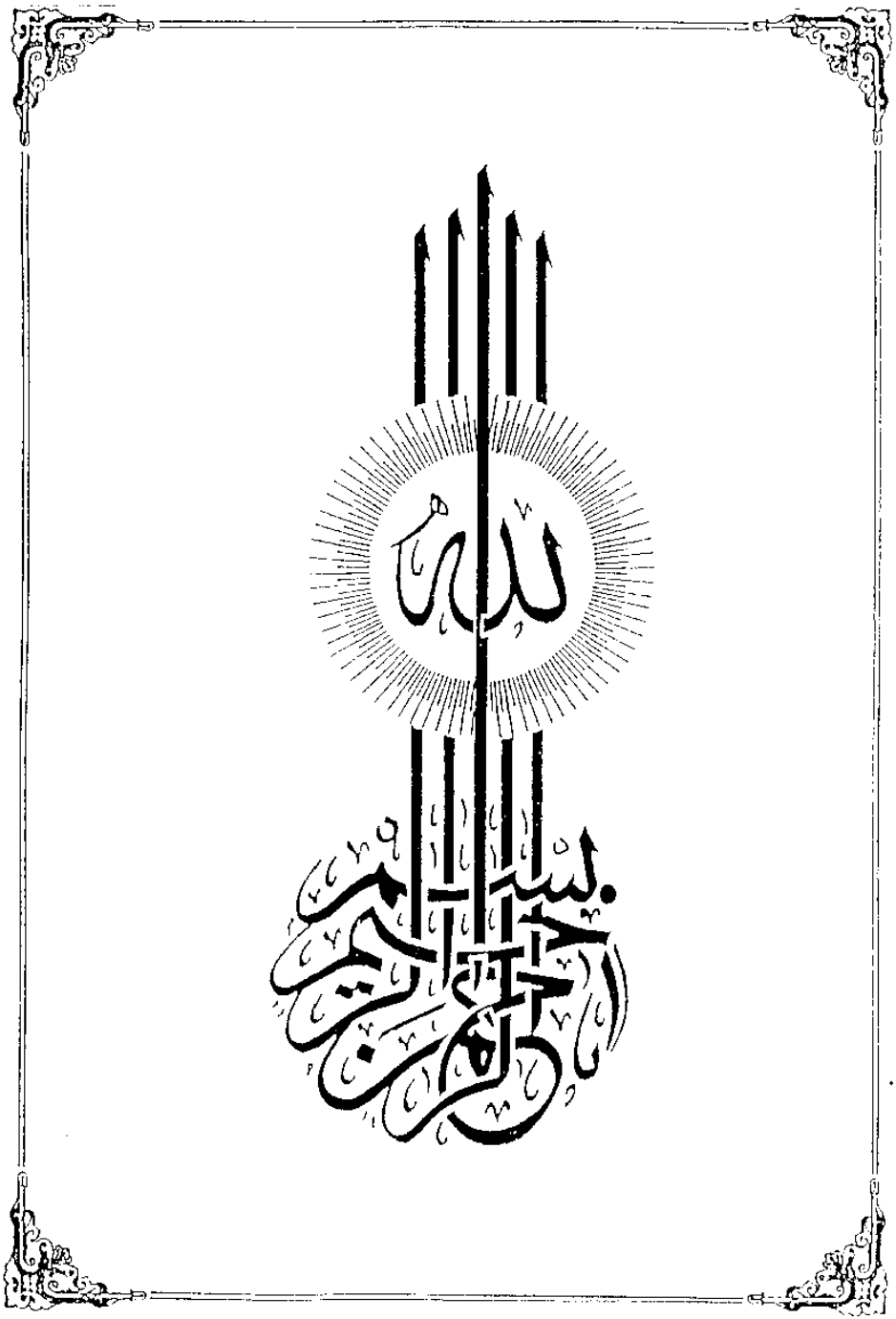

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I. INTRODUCTION

In most insects which had been studied, distinct fluctuations in the protein concentration of the haemolymph were associated with oocyte maturation. These fluctuations are belived to reflect the net balance between variations in the rates of protein synthesis and its release by the fat body and the rate of protein uptake by the oocytes.

In many insect species, proteins in the haemolymph are selectively incorporated into the yolk of developing oocytes and eventually comprise 70-90% of the total yolk protein (Highnam and Hill, 1977). These proteins have been termed vitellogenic-female proteins, i.e., female specific proteins because they are essential to yolk formation and characterize the egg of maturing female.

The electrophoretic and serological studies revealed that vitellogenic and total proteins are synthesized in the fat body.

Upon their release into the haemolymph, vitellogenic proteins are sequestered intact by the oocytes whereupon they may be complicated to form less soluble yolk-protein aggregates (Brookes,

1969: Dejmal and Brookes, 1972; Chen et al., 1976; Koeppe and Ofengand,1976). Quantitative changes in the protein content of the fat body and haemolymph of Melanoplus sanguinipes during each gonadotrophic period suggest that extra-ovarian protein plays an important role in oocyte development (Elliott and Gillott, 1977 and 1978).

The present investigation aims to evaluate the biochemical processes which are involved in the tissue building and oogenesis of the last nymphal instar and the adult stage of S.gregaria. This work includes the following :

1. The fluctuation in haemolymph total proteins of S. gregaria.
2. Qualitative and quantitative estimation of bound amino acids and free amino acids of the adult haemolymph.
3. Electrophoretic fractionation of S.gregaria haemolymph protein.
4. The correlation between the total esterases activity and haemolymph protein concentrations in the haemolymph of the adult stage.

II. REVIEW OF LITERATURE

2.1. Protein dynamics during insect development and reproduction :

During the immature and mature stages development, the fat body in insects is responsible for the synthesis of major haemolymph different proteins and serves at the same time as storage site of these components, in addition to carbohydrates and lipids. In the adult female it is the site where most yolk proteins or vitellogenin are produced. The fat body in insects fulfills a variety of functions similar to the liver in mammals. All these activities appear to be stage-specific and are under hormonal control.

Highnam (1962) stated that, ovarian development in the desert locust S. gregaria, is controlled by the cerebral neurosecretory system. This system is responsible only for synthesis and release of materials into the haemolymph during the development of the terminal oocytes of the ovary.

The changes in the haemolymph protein concentration had been measured in S. gregaria females. during ovarian development by Hill (1962). He

found a high haemolymph protein concentration correlated with an active neurosecretory system and developing ovaries. There were opposite correlations between the haemolymph amino acids and protein concentrations, which indicates that it acts as a pool for protein synthesis. Three fractions of haemolymph protein were demonstrated by electrophoresis; one of these increased greatly after ovariectomy and during yolk deposition and thus seems to be concerned with ovarian development.

Norris(1954) stated that, during the period immediately after emergence, the locust rapidly increases in weight. The tissues are being built up at the expense of the haemolymph amino acids. Also, during ovarian development a significant fall occurs, with a rise at the end of yolk deposition.

On the basis of experiments tackled with the desert locust, S. gregaria, Highnam (1964) proposed that, yolk deposition requires the action of two hormones, the protein uptake by

the oocytes being controlled directly by juvenile hormone (JH), while neurosecretory material of the corpus cardiacum serves to stimulate the secretion of vitellogenic proteins. Juvenile hormone (JH) itself has been stimulated blood protein synthesis (Thomas and Nation, 1966; Minks, 1967, Lucher, 1968).

Hammock et al. (1975) found that the main function of JH-binding protein in the haemolymph of Manduca sexta appears to be the protection of JH from degradation by general esterases during transport of hormone from corpora allata (CA) to target tissue.

The relationship between oocyte proteins and haemolymph proteins has been studied by; Wigglesworth (1964) and Telfer (1965) who reported that blood proteins play a major role in oocyte development.

Moreover, Minks (1967) stated that, juvenile hormone switches total protein synthesis in the fat body to vitellogenin synthesis. Also the JH controls the uptake of vitellogenin by the oocytes (Pratt and Davey, 1972).

Fluctuations in the protein concentration may be due to corresponding changes in the haemolymph volume which may alter protein levels (Engelmann and Penney, 1966; Bell, 1969 and Scheurer, 1969). The latter influence may be of minor consequence in normal vitellogenic females. But it is of particular importance when interpreting the effects of allatectomy and median neurosecretory cells cautery on the haemolymph protein concentration. Under these conditions, the concentration will be altered not only by interference with the synthesis and (or) uptake of protein but also by a disruption in water balance (Engelmann, 1970).

2.2. Changes in the level of nucleic acids during insect growth and development :

Kleinow et al. (1970), studied the formation of mitochondria in Locusta migratoria flight muscle. They stated that, the new mitochondria form in insect tissues during periods of rapid growth is associated with the moulting cycles and metamorphosis. For example, structural and

enzymic proteins of mitochondria increase by 60-fold during the formation of adult muscles in the locust.

H^3-Uridine was used to study RNA synthesis during the last nymphal instar of L. migratoria migratorioides by Geard and Loughton (1976). Autoradiographic data indicated that all tissues participated in RNA synthesis at all stages of development. In all cases the nuclear grain counts were higher than those of the cytoplasm. Each tissue showed characteristic changes in uridine incorporation. Two general patterns of activity could be distinguished. Fat body, mid-gut and oenocytes showed two peaks of incorporation during development one shortly after ecdysis, and the second starting at apolysis and continuing in the pharate adult. Epidermis, heart tissue and prothoracic gland showed a single peak of incorporation initiated immediately prior to apolysis and continuing in the pharate adult stage. RNA synthesis appeared to be accompanied with the known physiological activities during the 5th instar. (Geard an Loughton, 1976).

2.3. Amino acids metabolism and absorption in insects :

Haemolymph is the only extracellular fluid in insects. It exists in an unbound, non-vascular state, in direct contact with the tissues and organs. The chemical composition of haemolymph is highly variable among the diverse species examined and at different developmental stages of the same species. (Florkin and Jeuniaux, 1974).

Kilby and Neville(1957) studied the amino acids metabolism in locust tissues and found that the homogenates of fat body of S. gregaria, catalize transamination reactions between α-ketoglutarate and numerous α amino acids. The asparate/glutamate and alanine/glutamate transaminases were the most predominant. They were present in both the soluble and mitochondrial fractions of fat body cells and also in malpighian tubules and mid-gut wall. The other transaminases in the fat body were confined to the mitochondrial function.

Treherne (1959) investigated the amino acids absorption in the locust S. gregaria. He deduced